WOODS HOLE OCEANOGRAPHIC INSTITUTION

Reference No. 65-4

A SHIPBOARD CABLE-HAULING SYSTEM FOR LARGE ELECTRICAL CABLES

WOODS HOLE, MASSACHUSETTS

WOODS HOLE OCEANOGRAPHIC INSTITUTION
Woods Hole, Massachusetts

Reference No. 65 - 4

A SHIPBOARD CABLE-HAULING SYSTEM FOR LARGE ELECTRICAL CABLES

by

F. R. Hess and L. V. Slabaugh

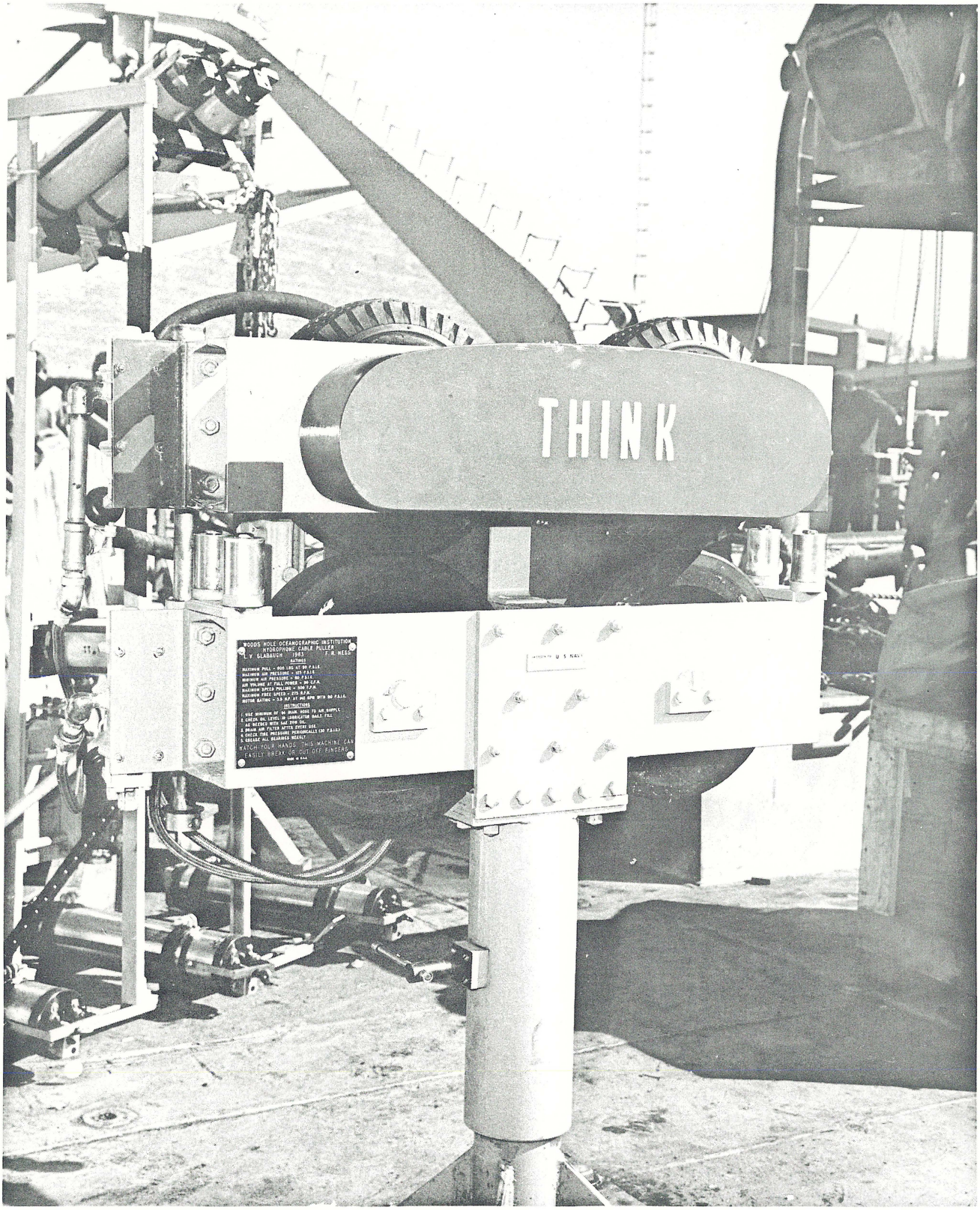
Submitted to Undersea Warfare Branch
Office of Naval Research

Under Contracts Nonr-4029(00) NR 260-101

February 1965

J. B. Hersey

J. B. Hersey, Chairman
Department of Geophysics



Finished cable puller installed on R/V Chain
for International Indian Ocean Expedition.

ABSTRACT

An air-powered hauling machine and reeling device for use at sea with large electrical cable systems such as hydrophone arrays is described. The system may be used to haul cables from 0.3 to 2.0 inch diameter. Hauling tensions up to 980 lbs. and speeds up to 430 ft/min. are provided. The principal advantage of the system is that it does not cause the cable to bend while under tension. Reeling is accomplished under only sufficient tension to cause the cable to conform to the reel.

INTRODUCTION

The increased use, during the past several years, of large electrical cable systems at sea has created a need for a new cable hauling system. Hydrophone arrays, towed magnetometers, geomagnetic-electrokinetographs (GEK) and other towed devices pose problems in retrieval, especially while underway. Their cables are often variable in length (i.e., consisting of removable sections) as well as in diameter. It is not practical, both for economic reasons and due to lack of space aboard ship, to provide separate winches for each cable system. Additionally, many of the cables, especially the larger ones, do not lend themselves to bending around small diameters such as capstans without the danger of permanent damage to the cable. While capstans of sufficient diameter to eliminate this problem exist, they are generally very slow, large, and much more powerful than necessary. Hauling the cables by hand is time-consuming.

The air-powered hauling system developed at the Woods Hole Oceanographic Institution (Fig. 1) solves these problems by providing a hauling machine sufficiently flexible to handle a wide range of cable sizes without damage. The hauling machine (Puller as it has come

THE PULLER

The Puller consists of three major assemblies: the base, the idler carriage, and the motor-drive carriage (Figs. 2 and 3).

Base

The base assembly is the pedestal containing the thrust and radial-load bearings. The pedestal may be swiveled in any horizontal direction so that the Puller can follow the changing lead of a cable as it is being pulled or locked by a clamp in any position. The entire base assembly is fabricated of stainless steel, because, although this material is expensive and difficult to work, it is the base of the unit that gets the most abuse. One-inch bolt holes are provided on 24-inch centers for mounting on the deck.

Idler Carriage

The idler wheel assembly, or lower carriage, is an aluminum box frame mounted on the swiveling platform at the top of the pedestal. It contains grooved idler wheels with integral ball bearings in their hubs Mounted on the outside of the box frame are the filter-lubricator, air-supply hose connections, air gauge, reel-motor valve, cable-guide rollers, two lift cylinders, and lift-cylinder valve.

The filter-lubricator cleans the air supply and injects a continuous spray of oil into the air system. The oil mist is essential for proper operation of both the lift cylinders and the air motor, as it continuously lubricates and provides a rust-preventing coating to all the working parts of the air system.

Hose connections are provided for connection to the ship's air supply and to the reel motor (or other auxiliary device). A gauge is provided for monitoring the line pressure.

A double-acting spool valve is mounted on an extension at the rear, or inboard, end of the Puller. It controls the two lifting air cylinders on the idler frame. The cylinders are a small double-acting type used originally in aircraft; almost any small double-acting air cylinders capable of exerting about 100 lbs. of force will suffice.

Two rod guides with nylon bushings constitute the slide bearings for the motor-and-drive carriage above and are aligned with two corresponding guides on that carriage. They carry 1.25-inch stainless-steel shafts upon which the upper carriage rides.

Motor-and-Drive Carriage

The upper unit, the motor-and-drive carriage, carries the driving motor, chain drive, driving wheels, and throttle valve. It is supported on two guides, identical with those on the idler carriage, and can be raised and lowered on the sliding vertical shafts. The lifting and closing forces are provided by the air cylinders connecting the motor-and-drive carriage to the idler carriage.

The driving motor, a 3.5-horsepower gear-head air motor, drives the two pneumatic driving wheels through two lengths of 3/4-inch pitch, number 60, roller chain. For general use, all three sprockets are 19-tooth; when a greater pulling power is needed (with some sacrifice in speed), a 9-tooth sprocket is attached to the motor shaft in lieu of the 19-tooth one. The air motor is non-reversing (the cable would not push very well, anyway). The wheel bearings are a self-aligning type and are the only non-stainless-steel fittings on the machine.

The driving wheels are of a standard pneumatic type made for "go-karts". They are mounted on aluminum hubs keyed to the driven shafts. There are ports in the box frame for checking tire pressure.

The throttle valve is a variable-volume spool valve which is spring-loaded to the "off" position. This results in a "dead-man throttle" control.

Finish

The aluminum parts of the machine are protected from corrosion with an epoxy chemical-resistant paint. A primer and finish coat are used; the result is a hard, durable, and well-bonded coating which has resisted salt spray for several months with no evidence of corrosion. The stainless-steel base unit is not painted but is left in the original passivated-surface condition.

MOTOR-DRIVEN REEL

The motorized reel is an adaptation of a standard WHOI reel stand. An aluminum post, mounted on one side post, supports the motor. The motor is mounted on a small carriage block with two studs protruding to ride in the slots in the mounting post. Vertical adjustment, for the accommodation of various sizes of reels, is provided by a slot in the post.

The reeling motor is air-driven and supplied with air from the auxiliary outlet and valve on the Puller. This motor is intended not for pulling the cables, but only as a takeup device.

SYSTEM CHARACTERISTICS AND SPECIFICATIONS

Puller

Motor type: Ingersol-Rand 4800S vane-type air motor.

Motor rating: 3.5 hp at 145 rpm with 90 psi air supply (125 psi max.).

Max. cable pull: 480 lb. (with 19-tooth driving sprocket).
980 lb. (with 9-tooth driving sprocket).

Cable speed at max. pull: 225 ft/min.

Cable speed at no load (max.): 430 ft/min. (with 19-tooth sprocket).

Reeling motor

Motor type: Ingersol-Rand 1841U vane-type air motor.

Motor rating: 1.2 hp at 150 rpm with 90 psi air supply.

Motor free speed: 340 rpm.

Max. cable pull: 150 lb. for 4' diameter reel (varies as reel diameter).

PERFORMANCE

This cable-hauling system has proven itself during a period of more than six months at sea. During this time the only failure which occurred was a temporary freeze-up of the motor due to inadequate oil feed in the lubricator. The time saved and the relief from manual retrieval afforded the ship's party, have more than paid for the system.

The Puller has been called upon successfully to haul cables ranging from a .375-inch diameter GEK cables to a 2-inch manila hawsers (when the stern capstan on the ship had failed). There has been no cable slippage even with wet rubber or plastic sheathed cables. When the base clamp of the Puller is released it will follow the lead of the cable being pulled with no control by the operator.

A complete set of mechanical drawings of the system is available on request from the authors.

LIST OF FIGURES

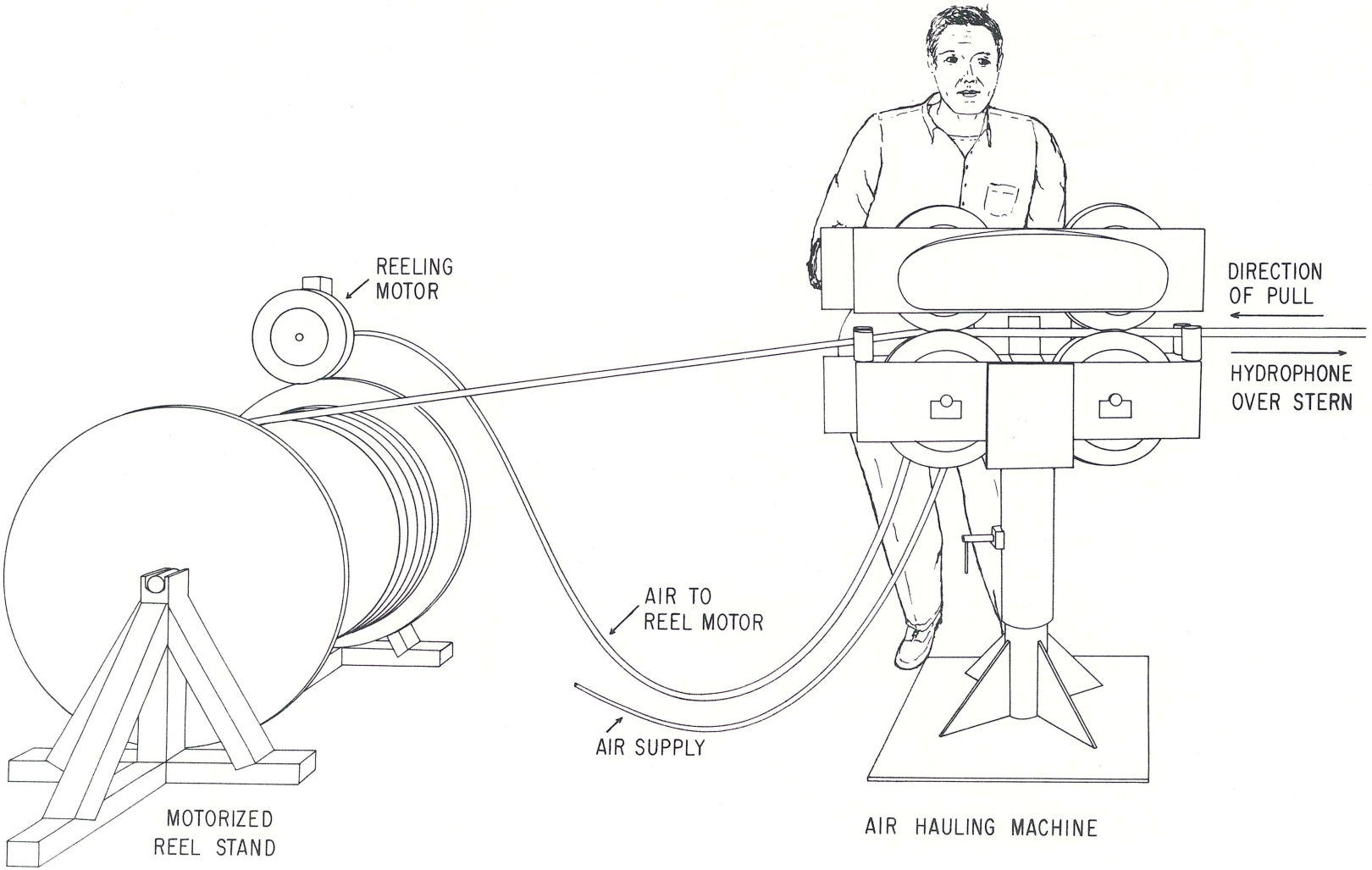


Fig. 1. Air-Driven Hauling System Set Up for Use. Operator has complete control of both hauling and reeling.

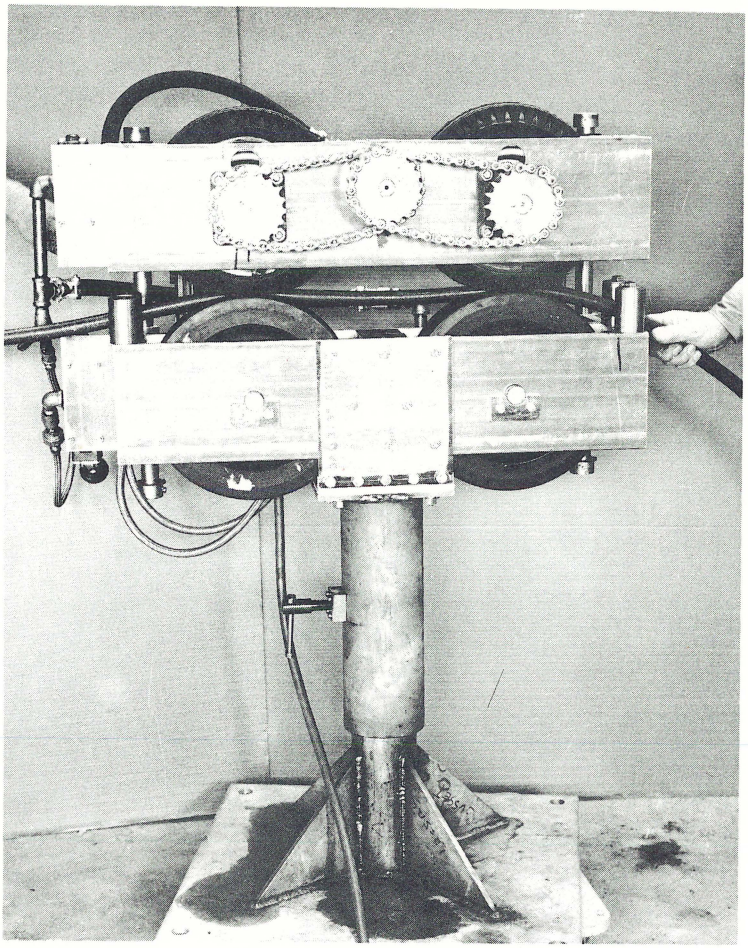


Fig. 2. View of Puller from Loading Side Showing Cable in Position for Pulling.

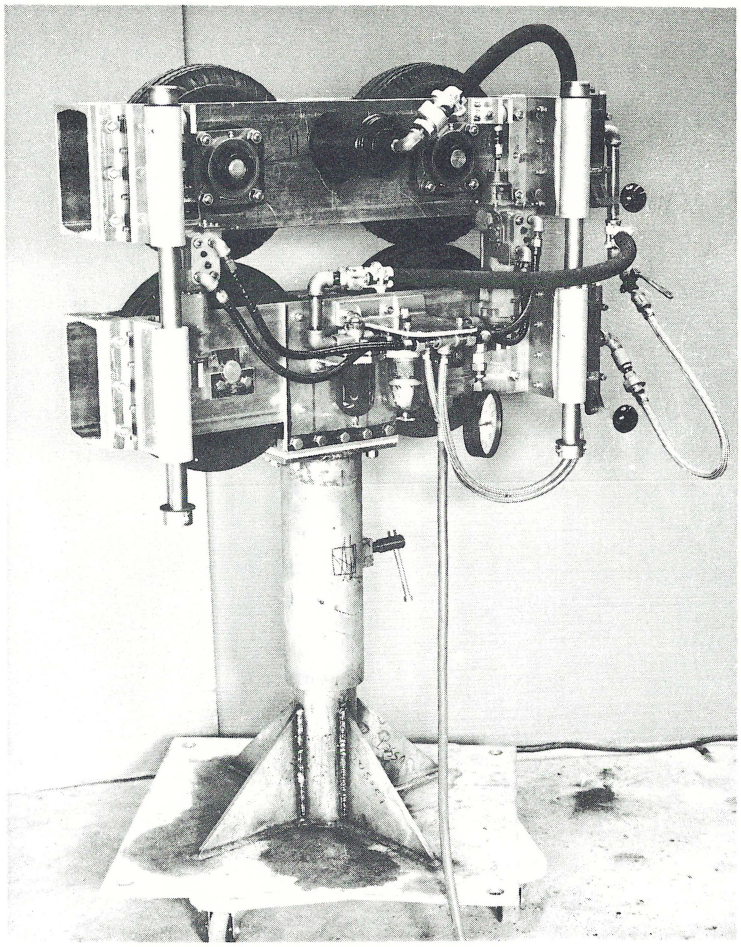


Fig. 3. Rear of Puller Showing Throttle Valve (Upper Right) and Lift Cylinder Control Valve Below. Air Filter-Lubricator in Center.

DISTRIBUTION LIST

	No. of Copies
Bell Telephone Laboratories, Inc. Whippany, New Jersey Attn: Mr. C. F. Wiebusch, Div. 54	1
Chief, Bureau of Ships Department of the Navy Washington 25, D. C. Attn: Code 335	1
Code 341	1
Code 631	1
Code 689B	1
Oceanographer (RU222) Bureau of Naval Weapons Department of the Navy Washington 25, D. C.	1
Director Hudson Laboratories 145 Palisade Street Dobbs Ferry, New York	1
Oceanographer U. S. Naval Oceanographic Office Washington 25, D. C.	2
Director Lamont Geological Observatory Torrey Cliff Palisades, New York	1
Systems Analysis Group Undersea Warfare Research and Development Council Room 5-224 U. S. Naval Ordnance Laboratory White Oak Silver Spring, Maryland	1

	No. of Copies
Bureau of Naval Weapons Department of the Navy Washington 25, D. C.	1
Office of Naval Research Department of the Navy Washington 25, D. C.	
Attn: Code 468	1
Code 416	1
Code 418	1
Code 466	2
Director Defense Research Laboratory University of Texas Austin, Texas	1
Commander Submarine Development Group TWO c/o Fleet Post Office New York, New York	1
Director Department of Oceanography Texas A. and M. University College Station, Texas	1
Director Marine Laboratory University of Miami 1 Rickenbacker Causeway Virginia Key Miami 49, Florida	1
Librarian U. S. Naval Postgraduate School Monterey, California	1

	No. of Copies
U. S. Naval Ordnance Test Station Pasadena Annex 3202 East Foothill Boulevard Pasadena 8, California Attn: Pasadena Annex Library	1
Commander (Code 753) U. S. Naval Ordnance Test Station China Lake, California Attn: Technical Library	1
Commanding Officer U. S. Naval Underwater Ordnance Station Newport, Rhode Island	1
Office of Naval Research Project Officer U. S. Navy Sofar Station APO 856 c/o Postmaster, New York	1
Office of Naval Research 495 Summer Street Boston, Massachusetts	1
Commanding Officer U. S. Navy Mine Defense Laboratory Panama City, Florida	1
Air Force Missile Test Center Technical Library, MU-135 Patrick Air Force Base, Florida	1
U. S. Navy Research Laboratory Washington, D. C. Attn: Code 2021	1
Code 5500	1
Code 5510	1

	No. of Copies
Commanding Officer and Director U. S. Navy Underwater Sound Laboratory Fort Trumbull New London, Connecticut	2
Commanding Officer U. S. Naval Ordnance Laboratory White Oak, Silver Spring Maryland	2
Commanding Officer and Director (Code 560) David Taylor Model Basin Washington 25, D. C.	2
Applied Physics Laboratory University of Washington 1013 East 40th Street Seattle 5, Washington	1
Director U. S. Naval Air Development Center Johnsville, Pennsylvania	1
Force ASW Officer Commander, Submarine Force U. S. Pacific Fleet c/o Fleet Post Office San Francisco, California	1
Anti-Submarine Defense Force U. S. Atlantic Fleet U. S. Naval Base Norfolk 11, Virginia	1
National Academy of Sciences National Research Council 2101 Constitution Avenue Washington, D. C. Attn: Dr. William Rainey	1

	No. of Copies
ONR Liaison Officer Woods Hole Oceanographic Institution Woods Hole, Massachusetts	1
Dr. G. P. Woollard, Director Hawaii Institute of Geophysics University of Hawaii Honolulu, Hawaii	1
Daystrom Electric Division of Daystrom, Inc. 753 Main Street Poughkeepsie, New York	1
Fluid and Solid Mechanics Laboratory Institute of Science and Technology Post Office Box 618 Ann Arbor, Michigan	1
Ordnance Research Laboratory Pennsylvania State University University Park, Pennsylvania	1
Commanding Officer and Director ASW Tactical School U. S. Atlantic Fleet Norfolk, Virginia	1
Commanding Officer and Director U. S. Navy Electronics Laboratory San Diego 52, California	2
Director Marine Physical Laboratory of the Scripps Institution of Oceanography San Diego 52, California	1

	No. of Copies
Anti-Submarine Warfare Research Center La Spezia, Italy	1
Commander Destroyer Development Group TWO c/o Fleet Post Office New York, New York	1
Commander Destroyer Flotilla THREE c/o Fleet Post Office San Francisco, California	1
Commanding Officer Anti-Submarine Defense Force U. S. Pacific Fleet Fleet Post Office San Francisco, California	1
Institute for Defense Analyses Communications Research Division Von Neumann Hall Princeton, New Jersey	1
Pacific Oceanographic Group Nanaimo, British Columbia	1
Defense Documentation Center Cameron Station Alexandria, Virginia 22314	20
Chief of Naval Operations Op-07T Washington 25, D. C.	1
Chief of Naval Operations (Op03EG) Department of the Navy Washington 25, D. C.	1

	No. of Copies
Seyir ve Hidrografi Dairesi Cubuklu-Istanbul, Turkey Via: ONR Branch Office London	1
National Institution of Oceanography Wormley Godalming, Surrey, England Attn: Library	1
Advanced Research Projects Agencies Pentagon Washington 25, D. C. Attn: Nuclear Test Detection Office	1
Director Bureau of Commercial Fisheries Biological Laboratory U. S. Fish and Wildlife Service Woods Hole, Massachusetts	1
U. S. Naval Applied Science Laboratory Code 9360 Naval Base Brooklyn 1, New York	1
Mr. R. H. Wilcox Information Systems Branch Mathematical Sciences Division Office of Naval Research (Code 437) Department of the Navy Washington 25, D. C.	1
Institute for Defense Analysis 1666 Connecticut Avenue Washington 9, D. C. Attn: Classified Library	1

	No. of Copies
Bermuda Biological Station St. George's West, Bermuda Attn: Mrs. Leida Piip, Librarian	1
Director Narragansett Marine Laboratory University of Rhode Island Kingston, Rhode Island	1

Woods Hole Oceanographic Institution
Reference No. 65 - 4

A Shipboard Cable-Hauling System for Large Electrical Cables (U) by F. R. Hess and L. V. Slabaugh, 7 p., 3 fig. February 1965

Unclassified

An air-powered hauling machine and reeling device for use at sea with large electrical cable systems such as hydrophone arrays is described. The system may be used to haul cables from 0. 3 to 2. 0 inch diameter. Hauling tensions up to 980 lbs. and speeds up to 430 ft/min. are provided. The principal advantage of the system is that it does not cause the cable to bend while under tension. Reeling is accomplished under only sufficient tension to cause the cable to conform to the reel.

1. Winches
2. Cables

I. F. R. Hess
II. L. V. Slabaugh

This card is UNCLASSIFIED

Woods Hole Oceanographic Institution
Reference No. 65 - 4

A Shipboard Cable-Hauling System for Large Electrical Cables (U) by F. R. Hess and L. V. Slabaugh, 7 p., 3 fig. February 1965

Unclassified

An air-powered hauling machine and reeling device for use at sea with large electrical cable systems such as hydrophone arrays is described. The system may be used to haul cables from 0. 3 to 2. 0 inch diameter. Hauling tensions up to 980 lbs. and speeds up to 430 ft/min. are provided. The principal advantage of the system is that it does not cause the cable to bend while under tension. Reeling is accomplished under only sufficient tension to cause the cable to conform to the reel.

1. Winches
2. Cables

I. F. R. Hess
II. L. V. Slabaugh

This card is UNCLASSIFIED

Woods Hole Oceanographic Institution
Reference No. 65 - 4

A Shipboard Cable-Hauling System for Large Electrical Cables (U) by F. R. Hess and L. V. Slabaugh, 7 p., 3 fig. February 1965

Unclassified

An air-powered hauling machine and reeling device for use at sea with large electrical cable systems such as hydrophone arrays is described. The system may be used to haul cables from 0. 3 to 2. 0 inch diameter. Hauling tensions up to 980 lbs. and speeds up to 430 ft/min. are provided. The principal advantage of the system is that it does not cause the cable to bend while under tension. Reeling is accomplished under only sufficient tension to cause the cable to conform to the reel.

1. Winches
2. Cables

I. F. R. Hess
II. L. V. Slabaugh

This card is UNCLASSIFIED

Woods Hole Oceanographic Institution
Reference No. 65 - 4

A Shipboard Cable-Hauling System for Large Electrical Cables (U) by F. R. Hess and L. V. Slabaugh, 7 p., 3 fig. February 1965

Unclassified

An air-powered hauling machine and reeling device for use at sea with large electrical cable systems such as hydrophone arrays is described. The system may be used to haul cables from 0. 3 to 2. 0 inch diameter. Hauling tensions up to 980 lbs. and speeds up to 430 ft/min. are provided. The principal advantage of the system is that it does not cause the cable to bend while under tension. Reeling is accomplished under only sufficient tension to cause the cable to conform to the reel.

1. Winches
2. Cables

I. F. R. Hess
II. L. V. Slabaugh

This card is UNCLASSIFIED

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

A SHIPBOARD CABLE-HAULING SYSTEM FOR LARGE ELECTRICAL CABLES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

5. AUTHOR(S) *(Last name, first name, initial)*

Hess, F. R. and Slabaugh, L. V.

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
February 1965	7	0

8a. CONTRACT OR GRANT NO.

Nonr-4029(00)NR260-101

b. PROJECT NO.

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)

Reference No. 65-4

9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*

10. AVAILABILITY/LIMITATION NOTICES

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

Office of Naval Research (Code 466)
Department of the Navy
Washington, D. C.

13. ABSTRACT

An air-powered hauling machine and reeling device for use at sea with large electrical cable systems such as hydrophone arrays is described. The system may be used to haul cables from 0.3 to 2.0 inch diameter. Hauling tensions up to 980 lbs. and speeds up to 430 ft/min. are provided. The principal advantage of the system is that it does not cause the cable to bend while under tension. Reeling is accomplished under only sufficient tension to cause the cable to conform to the reel.

DD FORM 1 JAN 64 1473

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

2*a*. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2*b*. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7*a*. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7*b*. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8*a*. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8*b*, 8*c*, & 8*d*. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9*a*. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9*b*. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers *(either by the originator or by the sponsor)*, also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this report from DDC."

(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."

(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."

(5) "All distribution of this report is controlled. Qualified DDC users shall request through _____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring *(paying for)* the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS), (S), (C), or (U)*.

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, roles, and weights is optional.